

# EXPLORE



Ocean Exploration  
2001 Annual Report

*“For thousands of years, humans have gazed out across the ocean and pondered what lay beyond the horizon. What we recognize today is that what lies below that horizon is just as important as what lies beyond it.”*

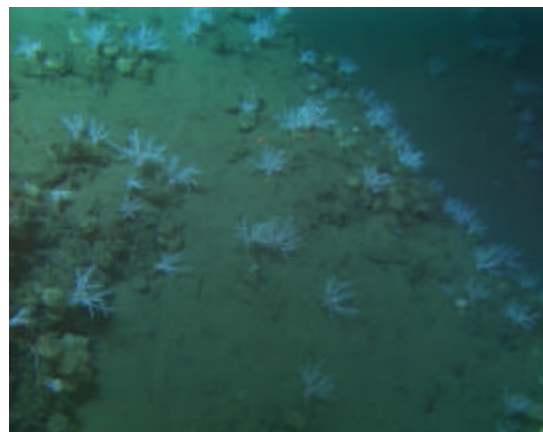
**Vice Admiral Conrad C. Lautenbacher, Jr., USN (Ret.)**

Under Secretary of Commerce for Oceans and Atmosphere  
and NOAA Administrator



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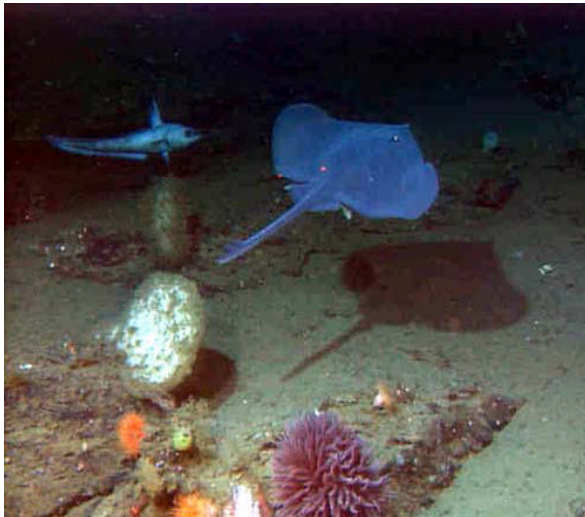


Above: Field of sea cucumbers along the steep slope of Astoria Canyon observed during the Lewis and Clark Legacy Expedition.

Left: A manta ray observed at Flower Gardens Bank National Marine Sanctuary.

# Ocean Exploration 2001

## Introduction



Underwater fauna viewed on ROPOS Dive R602 in the deeper portion of Astoria Canyon.

In June 2000, a U.S. panel of ocean scientists, explorers, and educators convened to create a National Strategy for Ocean Exploration. Their final report, "Discovering Earth's Final Frontier: A U.S. Strategy for Ocean Exploration," is a plan to undertake new activities in ocean exploration. The National Oceanic and Atmospheric Administration (NOAA) has embarked on this new strategy through its Office of Ocean Exploration (OE), and has created new partnerships with public, private, and academic ocean exploration programs throughout the community of ocean science.

## The Ocean Exploration Mission

The NOAA OE Program's mission is to search and investigate the oceans for the purpose of discovery and the advancement of knowledge of the ocean's physical, chemical and biological environments, processes, characteristics, and resources. OE accomplishes this through interdisciplinary expeditions to unknown, or poorly known, regions and through innovative experiments. The Program advocates discovery-based science and collaboration between multiple partners and disciplines. Education and outreach are cornerstones of NOAA's new OE Program.

True to the vision described in, "Discovering Earth's Final Frontier: A U.S. Strategy for Ocean Exploration," NOAA OE funded pathfinding ocean exploration projects in 2001. These projects and expeditions brought some of America's brightest ocean scientists and most enthusiastic ocean outreach specialists and educators together to pursue exploration in the Pacific, Atlantic and the Gulf of Mexico. This work brought NOAA to the frontier of ocean regions and shared that work with millions of explorers across the Nation.

This report details NOAA OE accomplishments in its inaugural year and describes each major expedition and project undertaken in 2001.

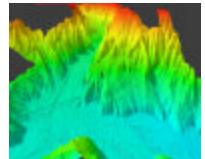
## Ocean Exploration Accomplishments Summary



n its inaugural year, Ocean Exploration has given NOAA and the Nation a new understanding of ocean regions, systems, resources, and life.

## **Miles mapped**

During the 2001 field season, over 3,200 square nautical miles were mapped using high-resolution tools. These new maps give scientists and natural resources managers the tools they need to make better decisions.



## **Ocean Frontiers**

- Biological diversity in previously unexplored regions was documented
- For the first time, scientists and explorers observed and filmed the formation of methane hydrates, a potential future energy source
- Ancient, inundated coastlines off the west coast of the United States were discovered, including the discovery of 14,000 year old intertidal mussel beds found near Heceta Bank

## **New Species Collections**

Several of the species collected during 2001 OE expeditions have never been described, including a number of invertebrates. OE Explorers also documented the extended known geographic range of many ocean species and deep sea communities.



## **America's Maritime Heritage**

- OE provided assistance to the U.S. Navy and the Monitor National Marine Sanctuary to raise the steam engine from the USS Monitor
- In the Thunder Bay National Marine Sanctuary, 11 known shipwrecks were located and 70 total targets were surveyed
- The US Navy submarine, the S5, was located and has been added to nautical charts and the historic shipwreck database

## **Outreach**

The Oceanexplorer.noaa.gov Web site receives an average of 1,400 “hits” per day and contains over 1,600 pages of information about our voyages and the oceans explored. Over 70 classrooms participated in the Deep East Expedition using lesson plans and educational products created for especially for the Deep East cruise.



## **Real time Data Delivery**

For the first time, 700 Megabytes/day of real time underwater sound files are being delivered to scientists, resource managers and students, via the Internet, from hydrophones installed on Pioneer Seamount, off the California coast.



## Ocean Exploration 2001 Expeditions and Projects

## Deep East

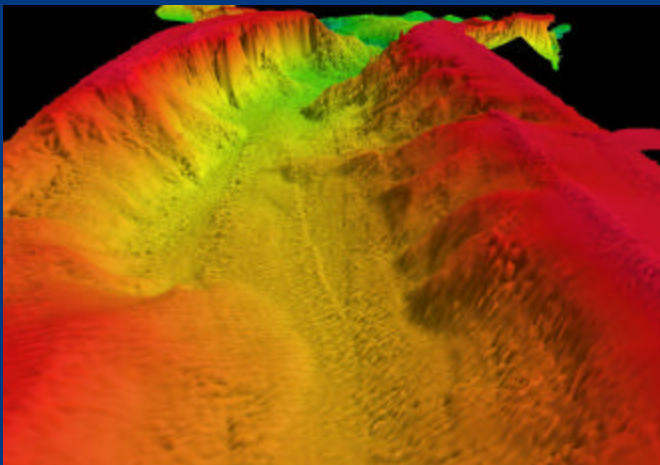
In an exciting expedition during September and October of 2001, scientists explored three regions of the Atlantic Ocean stretching from Maine to Georgia, including the submarine canyons of Georges Bank and Bear Seamount off the New England coast; Hudson Submarine Canyon, an ancient extension of the Hudson River Valley that extends more than 400 nautical miles seaward from the New York-New Jersey Harbor; and Blake Ridge off the Georgia coast. Even though these areas are very close to home, until now very little was known about the living and nonliving resources found there. Using the manned submersible *Alvin*, scientists ventured to the bottom of the Atlantic, collected video, took measurements of the biological, geological, and chemical features of these areas, and brought back biological and geological samples for further analyses. During the expedition Scientists focused on the examination of deep-water corals, methane hydrates, and discovered previously unknown deep sea resources and ocean processes.



A deep sea anemone seen from the *Alvin* on Blake Ridge during the Deep East Expedition.

## The Lewis and Clark Legacy Expedition

In the spirit of discovery defined by the original Lewis and Clark Expedition, ocean scientists explored the little known submarine abyss of Astoria Canyon. Just 10 miles offshore from the mouth of the Columbia River, the most westward reach of the famous 19th century explorers, these depths were virtually unexplored. The region's active tectonic setting suggested the potential for fluid or methane seeps in the canyon. Its sheer depth has stood as a "sentry," guarding the canyon from human intruders, and intrigued the researchers who hoped to discover untouched biological havens and even previously unknown species.



Three-dimensional image of the upper portion of Astoria Canyon.

The modern-day explorers plumbed the depths of Astoria Canyon with many technological tools that were unimagined in the time of Lewis and Clark. Sonar, hydrophones, high-resolution video, and a remotely operated vehicle called ROPOS are just a few of them. Once finished in the canyon, the exploration party headed to nearby Heceta Bank, a heavily fished underwater plateau. There, they assessed and compared its habitat with the nearly pristine environment of Astoria Canyon.

## Preserving the USS Monitor

The USS Monitor, launched early in the American Civil War, has been called the U.S. Navy's first modern warship. In 1975, her sunken and rusting hull became America's first national marine sanctuary. This expedition consisted of a five month effort by Navy divers to recover the Monitor's innovative steam engine and a section of her hull. The Navy employed a wide range of technologies in this effort, which was one of the largest archaeological recovery projects ever conducted. Monitor 2001 consisted of five expeditions to the Monitor National Marine Sanctuary, conducted in three phases. Each phase involved personnel from NOAA, the U.S. Navy, The Mariners' Museum and other organizations.



A U.S. Navy Diver prepares to descend on the U.S.S. Monitor.

## Sound in the Sea

In late August, scientists sailed from San Francisco to Pioneer Seamount, off the coast of central California, and installed underwater hydrophones (known as an array).

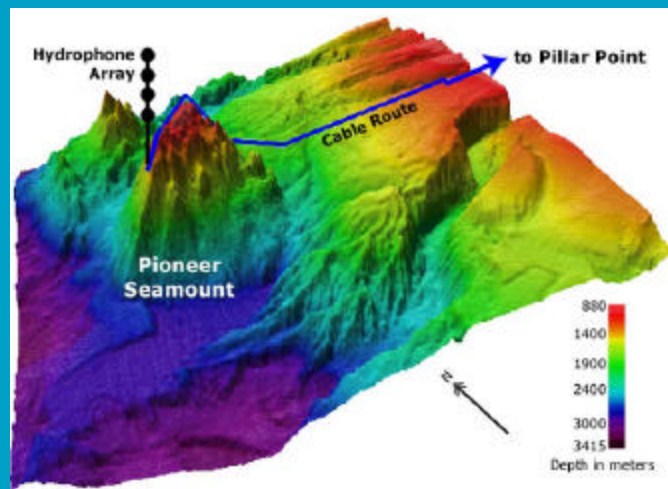


Diagram of the hydrophone array installed on Pioneer Seamount.

The hydrophones allow researchers to remotely monitor and record ocean sound to further their understanding of the sources and effects of ocean noise. The ocean sound data is now being transmitted live over the Internet. Passive underwater acoustic monitoring allows the detection of a variety of deep-ocean processes at long distances. Some of the sound sources to be studied include earthquakes, volcanic eruptions, landslides, marine mammal and fish vocalizations, weather, and manmade noises. The experience gained from this effort may enable scientists to expand the hydrophone arrays to other underwater cables that can be retrofitted. Ultimately, this could lead to a monitoring network capable of acoustic exploration throughout much of the global ocean.

## Thunder Bay

The Thunder Bay ECHO Expedition, undertaken with the Institute for Exploration and the Thunder Bay National Marine Sanctuary and Underwater Preserve, used sidescan sonar to survey "Shipwreck Alley" in the deep waters of the Thunder Bay National Marine Sanctuary and Underwater Preserve in Lake Huron. Explorers located and acoustically imaged the deep-water shipwrecks in the sanctuary. The project was conducted from June 8-22, 2001, off the northeast coast of Michigan's lower peninsula. From wooden sailing ships to early steamers to modern vessels, Thunder Bay has taken many ships to their watery graves. The collection of shipwrecks in Thunder Bay is a historical archive of commerce in the Great Lakes, as well as of the shipbuilding styles characteristic of the last century.



Sidescan image of the New Orleans located during the Thunder Bay expedition.

## Islands in the Stream

Islands in the Stream was a voyage to explore protected and non-protected coral reef and hard bottom communities -- the "islands" -- of Belize, Mexico and the United States, as well as the currents -- the Gulf "Stream" -- that connect these different habitats. The OE Expedition, one component of the Islands in the Stream Mission, concentrated on improving our understanding of coral reef and hard bottom communities off the Southeastern U.S. Operations included submersible and remotely operated vehicle (ROV) work, collection of oceanographic data, and surface, mid-water, and bottom sampling.



The *Clelia* submersible awaiting deployment on the Savannah Scarp.

## Next Generation Tools

The distribution and abundance of invertebrate organisms residing on or in the seabed, as well as the commercially-important species they support, are closely related to physical properties of the substrate. The Next Generation Tools expedition used a state-of-the-art Klein 5000 side scan sonar system and biological sampling to explore relationships between small-scale geological features and benthic communities in Alaskan waters. The primary objectives of the expedition were to evaluate advanced remote-sensing technology for future broad-scale seafloor

mapping expeditions and the feasibility of using ships of opportunity for this purpose.



Approximately 150 different species were collected during the Next Generation Tools Expedition.

Interferometric side scan sonar technology was selected for this study because it is towed close to the seafloor and is thus uniquely able to detect subtle variations in seabed composition and morphology. The Klein system was used because its multibeam technology not only produces extremely high resolution imagery, but the swath bathymetry feature enables efficient collection of precise seabed measurements as well.

## The Link Project

Exploration 2002, an international symposium for ocean and space technology innovation, will be The Link Project's next step to explore new opportunities for partnerships to advance ocean and space exploration. The upcoming symposium will help to continue a working relationship of technology collaboration between NOAA and NASA and their existing partnerships with industry and the private sector. This major symposium will present recent and future advances in technology that may benefit ocean and space exploration and research. Explorers who have been to the frontiers will share their stories of discovery and their visions for tomorrow. A future that includes deep-sea and interplanetary exploration, and the existence of previously undiscovered life, will be explored. Educational sessions and opportunities for professionals and students of all ages will also surround the symposium.

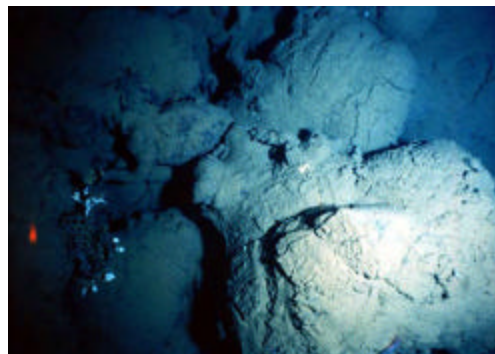


Sensor pods are being minaturized to benefit NOAA ocean exploration.



## Gorda Ridge

Together with Scripps Institution of Oceanography and the National Science Foundation, OE monitored post seismic activity in the Pacific Ocean off the Oregon coast in April. This event-driven cruise required fast mobilization of a platform and scientists to search for megaplumes in the water column after what was considered a significant seismic event was picked up by the SOSUS array. No significant thermal anomalies from hydrothermal plumes were in the area. Several dredges were collected to recover rocks from the seafloor, but they were all clearly old. The entire segment was resurveyed with multibeam sonar to compare with bathymetry collected before the earthquake swarm. In summary, no evidence for eruption of lava onto the seafloor has been found. It now looks like magma was injected into the seafloor, but none of it hit the surface. The work tells us more about how this gigantic system works and how these plumes impact the transport of heat, chemistry and microbes throughout the ocean.



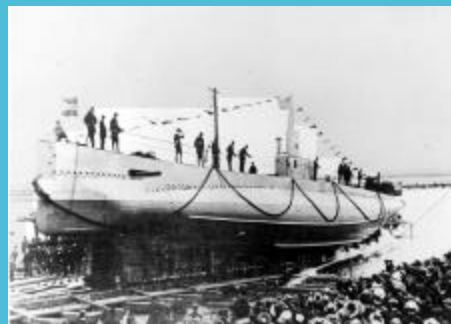
Old lava flows observed during the search for the Gorda Ridge Plume.

## East Coast Marine Archaeology

In July 2001, the NOAA Office of Ocean Exploration and the NOAA Ship WHITING teamed up to locate and image what may be a historically important Spanish shipwreck and the U.S. Navy submarine S-5, off Delaware Bay.

The S-5 was an American S-class submarine that foundered in 1920 during a routine test dive. The captain managed to float the 231-foot submarine upright in the water, with its stern afloat and its bow in the sandy seafloor. Miraculously, his plan worked; a passing ship caught sight of the S-5's stern and the crew was rescued, with no lives lost.

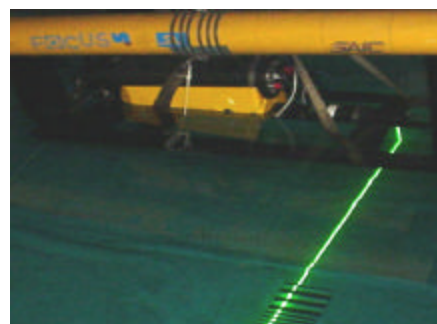
One of the Ocean Exploration goals is to improve knowledge of America's maritime heritage. This project located ships and submarines and will update their positions on nautical charts and augment our historical database. In addition, there is high public interest in chronicles about such wrecks as these.



The Navy S-5 Submarine

## Using Lasers to Explore Deep Ocean Life

Starting in November 2001, a team of scientists and ocean explorers will test the use of underwater electro-optic imaging technology (Laser Line Scanner, or LLS) as a nondestructive way to characterize fish and invertebrate populations and their habitats in deepwater. During this expedition, taking place in the Monterey Bay National Marine Sanctuary, a laser sensor will provide high resolution (mm-cm scale), high contrast images on a broader spatial scale than those possible using video observation platforms. This will be the first rigorous field-test of LLS and its ability to characterize deepwater seafloor habitats.



Laser being tested in tank prior to deployment in Monterey Bay.

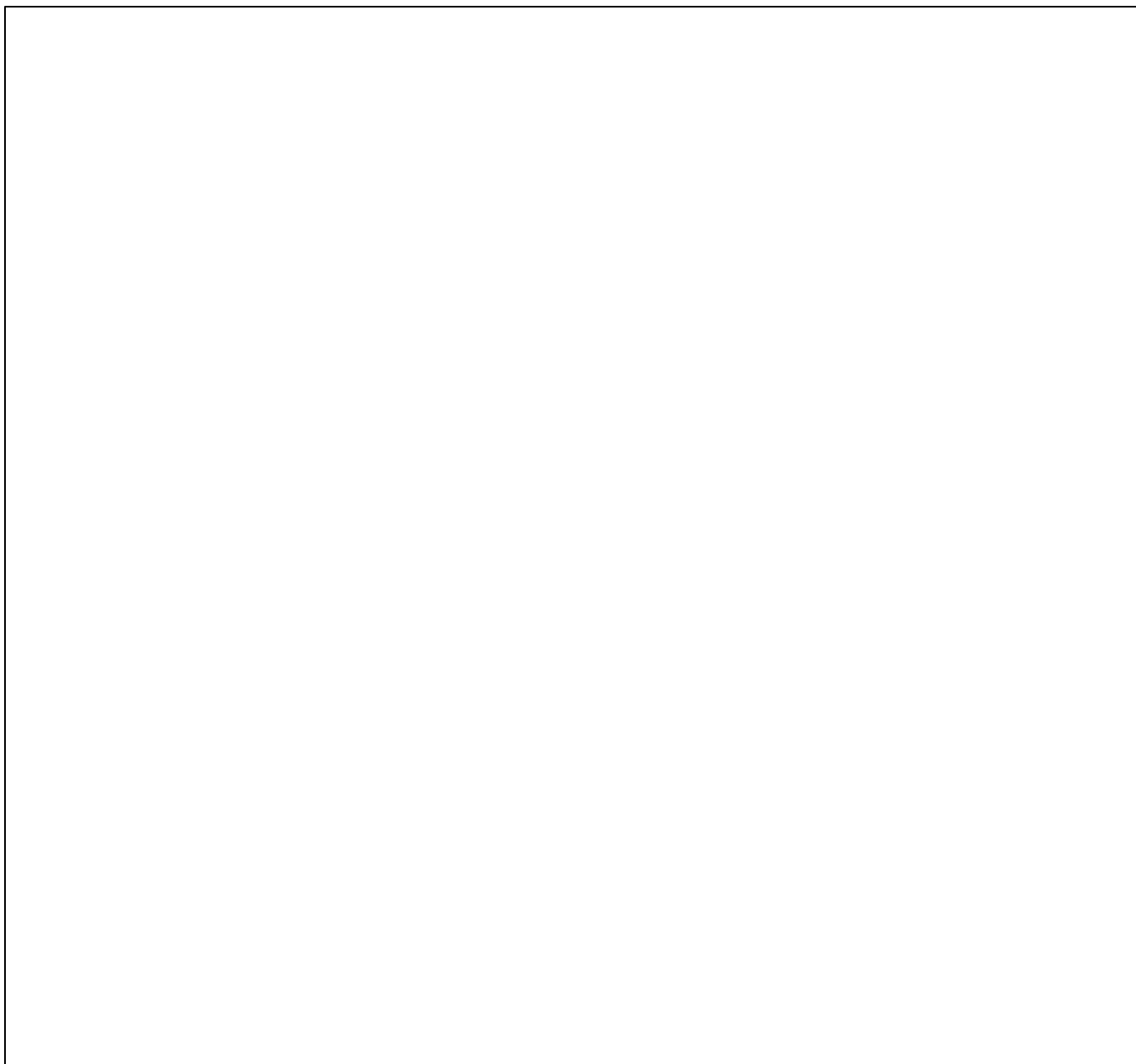
## The RMS Titanic

The RMS Titanic has been the subject of public attention in the years since the discovery of her resting place in 1985. With the passage of the Titanic Memorial Act of 1986, NOAA was given the responsibility of developing guidelines for activities conducted at the site. These guidelines were published in April 2001, after years of consultation with the international community and thorough review of documentation from previous expeditions, published literature, and a public hearing. NOAA visited the site for the first time this year, participating in two expeditions aboard the Russian research ship, Akademik Mstislav Keldysh, and at the invitations of both Deep Ocean Expeditions, and film director James Cameron. NOAA gained additional insight into the conditions at the site, and provided advice to the visiting expeditions.



The bow of the world's most famous underwater shipwreck

## Ocean Exploration 2001 Expeditions and Projects Globe



## Ocean Exploration Partners



## **Project**

## **Partners**

Deep East

National Undersea Research Program, Woods Hole Oceanographic Institution, University of Connecticut Avery Point, Rutgers University, University of Maine, University of North Carolina Wilmington, College of William and Mary, Louisiana State University, Georgia Institute of Technology, Wildlife Conservation Society, College of Charleston, NOS Coastal Services Center

The Lewis and Clark  
Legacy Expedition

Pacific Marine Environmental Laboratory, Northwest Fisheries Science Center, Oregon State University, Washington State University, Los Angeles County Museum, Mark Hatfield Marine Science Center, The Oregonian, Joint Institute for the Study of the Atmosphere and Ocean, University of Washington, Northwind Inc., Canadian Department of Fisheries, Olympic Coast National Marine Sanctuary, Pacific Marine Conservation Council, Southwest Fisheries Science Center

Preserving the USS  
Monitor

Monitor National Marine Sanctuary, U.S. Navy, Newport News Shipbuilding Inc., U.S. Coast Guard, Phoenix International Inc., U.S. Army Transportation Command, The Mariner's Museum, University of North Carolina Wilmington, East Carolina University, The Cambrian Foundation

Sound in the Sea

Pacific Marine Environmental Laboratory, University of Washington, Applied Physics Laboratory, Vandenberg Air Force Base, San Francisco State University, Monterey Bay National Marine Sanctuary, Scripps Institution of Oceanography, United States Geological Survey

Thunder Bay

Thunder Bay National Marine Sanctuary, The Institute for Exploration, National Geographic, State of Michigan

<b><u>Project</u></b>	<b><u>Partners</u></b>
Islands in the Stream	National Marine Sanctuary Program, Harbor Branch Oceanographic Institution, South Carolina Department of Natural Resources, Ft. Lauderdale Museum, Raleigh Museum, Governor's Office for the State of Florida, Florida State University, United States Geological Survey, Dynamac/National Aeronautics and Space Administration, Southeast Fisheries Science Center, University of North Carolina Wilmington, Savannah State University, College of Charleston, Oatland Island Education Center, Georgia Department of Natural Resources, South Carolina Aquarium, Phoenix International, NOS Coastal Services Center, U.S. Fish and Wildlife Service, North Carolina Department of Natural Resources, University of New Orleans, WSAV TV Savannah, National Estuarine Research Reserve, The Monitor Museum
Next Generation Tools	Alaska Fisheries Science Center, University of New Hampshire Joint Hydrographic Center, Klein Associates Inc., B and N Fisheries Company, U.S. Navy, Groundfish Forum, Triton Elics International, University of Alaska Fairbanks,
The Link Project	National Aeronautics and Space Administration, National Marine Sanctuary Program, Harbor Branch Oceanographic Institution
Gorda Ridge	Pacific Marine Environmental Laboratory, National Science Foundation, Scripps Institution of Oceanography, U.S. Coast Guard, University of Hawaii, University of Miami, Oregon State University, University of Washington
East Coast Marine Archaeology	NOAA Ship Whiting
Exploring Deepwater Habitat Using Lasers	National Undersea Research Program, Southwest Fisheries Science Center, Monterey Bay National Marine Sanctuary, SAIC, Northwest Fisheries Science Center, Moss Landing Marine Laboratories, University of New Hampshire Joint Hydrographic Center
RMS Titanic	Earthship Productions, James Cameron, P.P. Shirshov Institute of Oceanology, Russian Academy of Sciences, Deep Ocean Expeditions LTD

## Ocean Exploration Education and Outreach

**a**s cornerstones of the Ocean Exploration Program, education and outreach activities in year one demonstrated NOAA's ability to develop new products for scientists, educators and students of all ages. Our commitment to raising America's science literacy and engaging the broadest possible audience brought ocean exploration to an expanding ocean constituency. Outreach venues ranged from the White House Conference Center to classrooms across the Nation with the number of people reached climbing into the millions.

## **oceanexplorer.noaa.gov**

The Web site has been a tremendous outreach tool in year one. Early forecast estimates of the number of people who might be reached using the Web have been quadrupled during peak Web activity periods. The site now includes more than 175 essays and exploration logs from 95 contributors representing 20 NOAA and 25 non-NOAA institutions. This represents approximately 1,600 standard pages of content.

Contributors to the site include scientists, teachers, students, technicians, divers, photographers, artists, poets, archaeologists, historians, politicians, outreach specialists, ship captains and crew, engineers, marine protected area managers, and many more.

Since the site was launched June 1, 2001, site usage trends have climbed significantly. Total monthly requests (total files downloaded each month) on the site have grown from 420,000 in June to over 1,500,000 in September. Average daily sessions (people coming to the site each day) have grown from 511 in June to over 1,500 in September. Users are also spending more time on the site; average session length has increased from 4 minutes in June to 6 minutes in September.

## **oceanexplorer.noaa.gov**

## **Outreach Events**

A number of portside and Washington-based events during the year raised the visibility of Ocean Exploration to a number of audiences. Each was carefully planned, and facilitated through partnerships to leverage maximum participation and effective use of outreach funds. These following cities were the sites of major outreach events:

- Alpena, Michigan
- Newport, Oregon
- Charleston, South Carolina
- Galveston, Texas
- Washington, D.C.



Senator Ernest Hollings and Deputy Secretary of Commerce Samuel Bodman at Ocean Exploration Day in Charleston, South Carolina.

## New Products for Ocean Education



In its first year, OE brought ocean science to classrooms across the Nation.

“The Ocean has never been closer to the classroom.” This quote, and others heard during year one for OE, articulate the success NOAA has had in engaging explorers of all ages and all geographic areas. Lesson plans, teacher training workshops, web-based teaching materials have all made year one successful in directly reaching over 5,000 students. New products included teaching materials for deaf students developed as part of the Deep East Expedition Education package that includes lesson plans for grades 5-12. One of the key objectives articulated in the U.S. Panel report is “reaching out in new ways to stakeholders to improve the literacy of learners of all ages with respect to ocean issues. Our voyages during this first year have demonstrated the great potential ocean exploration has for generating exciting educational opportunities.

The Deep East Expedition teaching materials included Web-based student inquiry lesson plans, downloadable teacher training materials, teachers-on-board during the entire Deep East Cruise, and internet chats between teachers, scientists and students across the Nation. This suite of education products provides the model for similar educational offerings for future expeditions.

## Media Outreach

During its first year, OE has made an impressive appearance in news media, where stories in television, radio, internet news services and the press all featured the news of science, ocean exploration and port call activities. Ocean Exploration continues to prove itself a captivating news story, capable of engaging media of all types. NOAA's OE program will continue its outreach activities to enroll the media in new ways during upcoming expeditions.

### Sample of Ocean Exploration News Clips

Science - Oceangoing Lewis and Clark Expedition, January 15  
CNN.com - Scientists tune in to Sounds of the Sea, September 7  
Nature - To Boldly Go, August 16  
The Washington Post - An Undersea Canyon Reveals its Riches, July 16  
The Discovery Channel - Mysterious Undersea Canyon Explored, July 19  
The Associated Press - Scientists Uncover Secrets of Underwater Canyon, July 14  
The Associated Press - NOAA: Ocean Study Merits More Attention, October 2  
Carolina Morning News - NOAA Submersible Sinks to New Depths, September 27  
The Oregonian - Into the Abyss: Scientists Explore the Deep Astoria Canyon, July 11

# E d u c a t i o n a l   O u t r e a c h

In 2001, The NOAA Office of Ocean Exploration took the first steps in organizing and producing a national, systematic educational product for educators and students. The Deep East Educators Guide was created by NOAA OE and 36 professional teachers from schools in the three regions focused on during the Deep East Expedition. These teachers, understanding the benefit of using ocean exploration as a tool for building student's skills in math and science, established a successful template that can be easily used in other regions. The Deep East Educators Guide includes products for grades 5 through 12 and has been used in over 70 schools in 2001.



NOAA OE educational outreach program includes products for disabled students

An important aspect of OE's educational plan is to reach into segments of the student population that have been under represented by current educational programs. The Deep East Educators Guide includes a program for hearing impaired students, and opens the door for increased participation in ocean science and exploration for the deaf community. This endeavor has been particularly gratifying, and the Ocean Exploration program has been able to witness its positive impact in the deaf community. Students are showing more interest and aptitude for science based on interest created by ocean exploration.

## Deep East 2001:

**Voyage of Discovery to Deep Sea Frontiers off the East Coast**

**DSV Alvin**

**Atlantic Ocean**

**Georges Bank** 1

**Hudson Canyon** 2

**Blake Ridge** 3

**Educators Guide**

**Grades 9-12**

**EXPLORE**

National Oceanic and Atmospheric Administration (NOAA)

<http://oceanexplorer.noaa.gov/>

Deep East 2001—Grades 9-12  
Overview: Ocean Exploration

### Designing Tools for Ocean Exploration

**FOCUS**  
Ocean Exploration

**GRADE LEVEL**  
9-12

**FOCUS QUESTION**  
What types of tools and technology are used in ocean exploration?

**LEARNING OBJECTIVES**  
Students will understand the complexity of ocean exploration.  
Students will understand the technological applications and capabilities required for ocean exploration.  
Students will understand the importance of teamwork in scientific research projects.  
Students will develop abilities necessary to do scientific inquiry.

**ADAPTATIONS FOR DEAF STUDENTS**

- Teacher performs duties of Chief Scientist as well as captain. This eliminates the need for the mission log.
- All students work in one group and perform all samples.
- Pre-teach vocabulary.
- Chief Scientist prepares dive schedule and grid prior to beginning of lesson.
- Lesson will require three days.

**MATERIALS**  
**Simulated Ocean** (per class)

- 1 Container - (Garbage Can or Tupperware Container or Cooler (Min. 12" Deep and 2 feet by 2 feet square)
- 1 Sampling Grid the size of container (mark on the edges of the container as shown below to make the borders of the grid)

- Sand/Rocks/Gravel/Bricks - mixed together and placed in the bottom of the container enough to cover the bottom to about 2-3 inches deep
- Water (add salt if desired) - enough to fill the container to several inches from the top
- 3 bottles of dark food coloring - for least three colors to make water dark

**Bottom-dwelling "Organisms"** (per class)

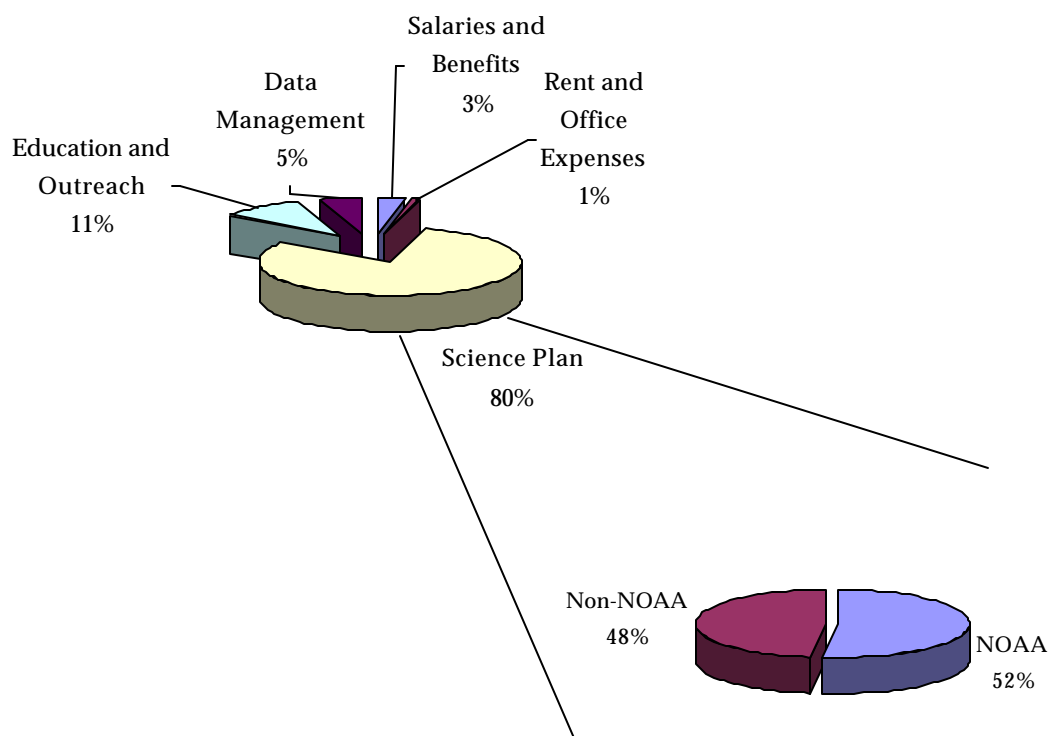
- 10 - 20 "simulated clams" - buttons, pennies, or foil (rolled into a ball the size of a pea)
- 10 - 20 "simulated worms" - wire, fishing line, small springs 1-2 inches in length
- 20 - 40 "simulated crustaceans" - rice, beans
- 1 bottle "simulated foraminifera" - glitter or small beads

New products for educators and students includes the Deep East Educators Guide

## Ocean Exploration 2001 Funds Allocation



**Ocean Exploration 2001**  
**2001 Appropriation - \$4M**





## Appendix I

### Congressional Support

## Appendix II 2001 Media Samples

**For more information, contact:**

The NOAA Office of Ocean Exploration  
1315 East West Highway, 10th Floor  
Silver Spring, Maryland 20910  
Tel: 301-713-9444  
<http://oceanexplorer.noaa.gov>



U.S. Department of Commerce/National Oceanic and Atmospheric Administration